PETROLEUM ENGINEERING POST-GRADUATE COURSE JOURNAL OF PRACTICAL TRAINING WITH HUMBLE OIL AND REFINING COMPANY.

D. H. GARLAND

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D. H. Garland
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PREFACE

This journal has been prepared in fulfillment of the requirements of Superintendent, U. S. Naval Postgraduate School for training with industry as a part of engineering postgraduate curricula.

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GENERAL ORIENTATION

6 July 1959 - Reported to headquarters office of Humble Oil and Refining Company in downtown Houston, Texas. Was met by Mr. Thomas Pennington of the Production Department, who was to be the overall coordinator of the training program.

Was given a general orientation on the scope of the company's operations, the organization of the Humble headquarters group, the relationship of Humble to its parent company, Standard Oil Company (New Jersey), and other affiliates, and the geographical extent of Humble's operating areas.

Humble's production is entirely domestic with 82% of this production in Texas. As a result of foreign crude oil imports, Texas has regulated the production of well allowables to approximately 9 days per month. This production curtailment has disproportionately affected Humble, making it more difficult to compete with companies which have major portions of their production abroad. The Humble company is presently conducting a general personnel and cost reduction program, attempting to offset this competitive disadvantage.

Mr. Pennington provided a detailed schedule of the training program with Humble and a briefing on this schedule.

The overall schedule with Humble was set up in a logical sequence such that the initial training would concern exploration for oil. Production training would follow , and ultimately, training in the marketing and supporting staff departments would complete the schedule.

EXPLORATION DEPARTMENT

7 July 1959 - Reported this date to commence training with Humble's Exploration Department. Was briefed on the organization of this department including both headquarters and field organizations. Humble exploration and production operations are divided into five major geographical areas. These are:

Eastern Division - Louisiana, Mississippi, Alabama, Florida

Four Divisions within Texas

In addition, there are limited operations in California and Alaska.

These divisions are generally divided to provide areas of near equal production activity. The Exploration Department is divided organizationally into five sections, both in the headquarters group and field offices. They are:

1. Land
2. Scouting
3. Geological
4. Geophysical
5. Clerical

Visits were made with the five sections of the exploration headquarters group where discussions were held with key personnel in regard to the functions of each section. As a result of a general company trend toward decentralization of responsibilities to the field organization, the

headquarters groups in all departments retain only coordinating and policy making functions.

The Land Section, in addition to its general functions regarding the acquisition and disposal of leases, concerns itself with the preparation of up-to-date figures on oil and gas reserves both in Humble fields and those of the rest of the industry. This information provides management with a comprehensive picture of the oil production industry's current status and Humble's relation thereto.

8 July 1959 - Visits with the headquarters exploration sections were completed on this date. A particularly interesting presentation was given by the Humble Chief Geologist including slides and maps describing the geological complex of the areas of Humble exploration and production. The major producing formations, Permian in West Texas, Mesozoic in East Texas and Tertiary in the Gulf Coastarea were described in considerable detail.

This gentleman had a close familiarity through personal experience with the geological makeup of Alaska. He discussed the geology of Navy Petroleum Reserve Four in Alaska where extremely shallow production had at one time taken place. Humble had recently invested several million dollars in an unsuccessful wildcat in southern Alaska. The extreme expense of this venture was largely caused by difficult drilling through permafrost to 1100 feet and rock formations most of the rest of the way. Additionally, logistics and

the extreme weather conditions at this remote drilling site were major problems.

9 July 1959 - Visits were commenced on this date with one of the operating divisions of the Exploration Department. This division whose operating area encompasses Southeast Texas adjacent to the Gulf Coast, is organizationally typical of other divisions, though many aspects of its geological makeup are rather unique. This area is well known in the petroleum industry for its prolific production from fields associated with salt domes.

The first section within Gulf Coast Division which was visited was Scouting. This section, as implied by its name, performs an intelligence gathering function by providing the division with timely information concerning exploration and drilling activities carried on by other companies within its domain. This information can be of tremendous assistance to Humble is judiciously planning its own exploration and drilling operations. Extensive files of this collected and sorted information were viewed during the visit with this section.

A field trip was made on this date with the division sulfur scout to a Frasch process sulfur mine associated with salt dome oil production. Though Humble does not have a direct interest in sulfur mining, it is so closely associated with Gulf Coast oil and gas production, that scouting operations on sulfur activities are carried on on a full

time basis.

10 July 1959 - In continuation of the visit with Scouting, a field trip was taken this date to a locality of active exploration and drilling operations. Our host for the trip, an oil scout, was observed in his various methods of information gathering from people and places along the route. Two drilling sites were visited where target zones were in the relatively deep Frio sands. This trip, being the first opportunity in the program with Humble to observe actual drilling, proved to be extremely interesting and enlightening.

Week of 13 July 1959 - A period of instruction with the Geophysics section of Gulf Coast exploration was commenced on this date. The three common types of geophysical prospecting for oil, seismic, gravimeter and magnetometer surveys, were explained, with particular emphasis on their application to exploration in the Gulf Coast area. Seismic reflective shooting has perhaps the greatest usefulness in locating subsurface geological structures and utilizes sound energy produced by explosive detonations reflected from structural anomalies into geophones at the surface.

A two day field trip was taken during this week to observe contract seismic crews conducting shooting operations in a new area of interest to Humble. The procedures of shot hole drilling, setting of geophones, detonation of explosives, field interpretation of reflection data and the

orientation of shooting locations on area maps were observed and explained. An appreciation was gained of the problems of access associated with prospecting in some new areas. One crew virtually had to cut its own path through one extremely heavily wooded section of East Texas.

A day was spent back at division headquarters studying the methods and equipment used in translating data on seismic tapes received from the field into graphical presentations useful to exploration geologists in making interpretations of subsurface structure. An ingenious electronic computer called a "playback" performs this translation. It was emphasized that the graphical presentations, though treated confidentially, give no positive description of subsurface structure. It is the interpretation of this information by competent and imaginative exploration personnel that actually influences new drilling ventures.

Gravimeter, magnetometer and dipmeter data interpretations were also touched upon. The gravimeter, with its sensitivity to variations in specific gravity among subsurface structures, has been helpful in discovering and locating salt dome formations common to the Gulf Coast. The dipmeter has been useful in verifying the dip and strike of formations in areas already drilled.

Week of 20 July 1959 - The Geological and Land sections of the division were visited during this week.

A rather detailed description of the geological makeup

of the Gulf Coast area was given by the division Chief Geologist. All of the major beds dip toward the coast and in many cases outcrop some distance inland.

Geological work at Humble is generally divided into two major groups, exploration and production. Exploration geology concerns the initial investigation of areas of interest including surface surveys, mapping of the subsurface using well log data, seismic data, and other sources of information. From these studies, anamolies of structure may be indicated giving hint of the possible location of oil or gas. Production geology, on the other hand, is that phase of the work taking place after spudding in at a drilling location. It includes observation of well cuttings, running of well logs, core cutting, well tests, interpretation of information from all these sources, and supervision of well completions.

During this week geological work of both types was studied, both at the division office and in the field. Field trips included a visit to a location in Galveston Bay where a deep gas well completion was being made and an inland drilling site where a mud logging program was being conducted.

The Land section, with a nucleus of legally trained personnel, concerns itself with buying leases, clearing lease titles, arranging field unitization and joint operations, arranging farm-outs and contributions (dry hole

money), and maintenance of the division's extensive lease records.

Week of 27 July 1959 - This week was spent in study of research exploration. This includes the fields of geological, geophysical and geochemical research. The greater part of this research work is conducted at Humble's new and well equipped reaearch center in Houston.

Geological research, and most other types in the company, is directed toward two general goals; first, service to the field organization in providing assistance in solving immediate problems of geology and geological interpretation, and second, longer range studies commonly called basic research. Research areas included:

1. Photogeology which correlates surface anomalies visible in aerial photographs with the occurrence of oil and gas.

2. Paleontology which utilizes fossils of small living organisms to date and correlate sedimentary beds.

3. Sedimentary geology in which sedimentary processes and their relationshop to the occurrence of oil and gas are studied.

4. Sedimentary petrology in which the mineral content of core samples is related to the chronological order of bed deposition.

Geochemical researchis concerned with age determination of sediments by measurement of the radioactive characteristics of certain elements in core samples, and study of

the chemical content of cores to determine the marine conditions under which sediments were deposited.

Geophysical research functions to develop new equipment and techniques for geophysical prospecting and assists in the development of new well logging equipment.

Week of 3 August 1959 - Training with the Production Department of Humble was commenced this week. The geographical organization of this department follows that of the Exploration Department previously described. Functionally, the department is divided into three general sections; production engineering, reservoir engineering and civil engineering. The Production Department training program was commenced with visits to groups within the Reservoir Engineering section.

An extensive schooling program for Humble petroleum engineers is carried on under the supervision of the Reservoir Engineering group at the Humble Research Center. Classroom schooling is supplemented in this program with actual work in the reservoir engineering service laboratories. During the visit with section, the curriculum of the school was described in some detail and the associated service laboratories toured.

These laboratories perform a twofold function. First, they provide services to the field of core and bottom hole sample analyses, and second they provide a check on the quality of similar work contracted by the company field organization with outside analysis laboratories.

Another service associated with these laboratories is that of formation evaluation. This service is performed by

specialists in well log interpretation who correlate the data provided by core analyses with corresponding data provided by various types of logs made on the same formations. Reports are prepared containing a comprehensive description of formation charactersitics.

Week of 10 August 1959 - This week was spent with several of the production engineering groups located at the Humble headquarters building. These groups give overall coordination to development of new equipment and techniques used in well completions and production. The subjects of wellhead equipment, casings, artificial lift equipment, well completions, workovers, corrosion problems and preventatives, surface separators, salt water disposal, and custody transfer equipment were discussed with these groups.

Two field trips were included in this week of training. Locations visited were Cameron Iron Works, a major manufacturer of well blowout preventers, Christmas trees, and other surface equipment; and Humble's experimental laboratory where well perforating tests , tubing strength tests and core fracturing tests are conducted.

Week of 17 August 1959 - This week was spent attending classes in drilling engineering, a part of the production engineering school conducted at the research center for company engineers. The instructors for this school were probably the best available on the subject, as they were all staff or field specialists from within Humble's own

organization.

Lecture and practice problem subjects covered during this week included drilling economics and planning, drilling fluids, drilling equipment, drilling hydraulics, bit selection, directional drilling, fishing, sidetracking, coring, drill stem testing and completion practices.

The lectures were well illustrated with Humble's experiences in the business, both good and bad, with particular emphasis on cheaper future well costs utilizing lessons learned from past operations.

Week of 24 August 1959 - This week was spent with the Formation Evaluation and the Computer groups of production at the research center.

The Formation Evaluation group had been previously visited during the week of 3 August, but during this period greater detail was covered, particularly the quanitative analysis capabilities of various types of well logging devices. Quantitative analysis in this particular case means the determination of formation porosity, water and oil saturations.

The Computer group, utilizing both Humble owned and IBM rented equipment, coordinates and supervises the working of numerous production department problems, both engineering and economic. Problems handled consist of two general types, those of a routine nature (oil flash calculations, waterflooding of reservoirs, cash flow analyses

of oil properties) and those requiring special programming for computer solution (new reservoir analyses, certain production problems and offshore platform design). For routine problems an extensive library of computer programs is maintained.

It was interesting to note that computers have generally not permitted any reduction in technical personnel in the company, but rather have made possible solution of problems previously too rigorous and complex to work practicably. The solutions derived have been a great assistance to management in providing sound analyses helpful in making decisions. Thusly, money savings have been realized through increased efficiency of company operations.

Week of 31 August 1959 - This week was spent with the Reservoir Analysis, the Reservoir Engineering Research and the Long Range Reservoir Planning groups.

The Reservoir Analysis group,containing some of the most experienced company reservoir engineers, coordinates the development of new techniques in reservoir work throughout the company. Additionally, this group has final review authority on reservoir and secondary recovery recommendations originated in the field before such matters are presented to management for approval.

Reservoir Engineering Research conducts rather detailed mathematical studies and experiments utilizing in many cases physical models simulating known reservoirs. Fluid flow

characteristics in these models are observed and recorded. From this work, information useful in predicting actual reservoir performance is obtained.

The Long Range Reservoir Planning group primarily deals in economics as related to Humble's future production operations. Notable among the company's economic policies is the stress being put on increasing current income, rather than increasing reserves. This, in general, means greater thought must be applied to improving recovery from known reservoirs, rather than finding new ones.

Week of 8 September 1959 - One day of this week was spent completing discussions with the long range group. Subjects covered were conservation of oil and gas, unitization, allocation formulae and proration in Texas and other states in which Humble has production.

The remainder of the week was spent in more detailed discussions of well completion and workover techniques with the production groups previously visited the week of 10 August. Many of the engineering aspects of workovers and well completions were dwelt upon. It was noted once again that through improved practices in completing and working over wells, greater ultimate production from known reservoirs is being sought. It had been emphasized by the Long Range Reservoir Planning group that the most economical additional barrel of oil can be produced from known reservoirs, in view of increasing costs of exploring for new oil.

Week of 14 September 1959 - In continuation of the overall training in Production Department operations, a five week period was commenced with one of Humble's operating divisions, the Gulf Coast Division. The Exploration Department in this operating division had been visited in July.

The purpose of this period of training was to observe more directly company day-to-day practices in production and reservoir engineering. As a beginning to this phase of training, we had the opportunity to sit in on a morning meeting of the division section heads with the division production manager. Here the morning reports of drilling and production progress and special problems were presented to the manager. He, in turn, was later required to make a report of this information to Humble headquarters management.

During the week discussions were held on production and drilling subjects similar to those previously covered while with the headquarters groups, However, at this level, their direct applications to day-to-day problems was emphasized, providing us a more practical understanding of the subjects.

Field trips this week included a visit to Friendswood field, where an echo sounding trouble shooting technique was being employed on a "sick" gas lift well; a visit to a Humble rig drilling a field wildcat; visits to Clear Lake and Point Barrow gasoline plants, where condensate laden

natural gas was stripped of its valuable liquid hydrocarbons. This field natural gasoline is piped to various refineries for use in processing or sold direct to marketers who, in turn, sell its various fractions as LPG (liquid petroleum gas).

Week of 21 September 1959 - During this week discussions were held on specific reservoir engineering studies made in the Gulf Coast division. Reservoir projects underway included: water flooding and gas injection to permit greater ultimate oil recovery, water flooding and gas injection to prevent retrograde condensation in a producing gas field, unitization of oil and gas fields for greater recovery efficiency and more equitable recovery among lease operators, and water and gas injection to prevent oil migration up into overlying gas zones which result in reduction of ultimate recovery.

A field trip was taken to the Katy gas field and cycling plant, one of the world's largest operations of its type. Cycling in this case is being conducted primarily because of an inadequate market for dry gas. At the same time good current income is being derived from sale of the extracted liquid hydrocarbons. These liquids were being fractionated into separated streams of field natural gasoline, n-butane, iso-butane, propane and an ethane-propane mixture.

Week of 28 September 1959 - During this week, well completion and workover practices and projects in the Gulf Coast Div-

ision were covered.

Troubleshooting of "sick" wells with casing or tubing leaks by use of temperature and pressure surveys was explained.

In conjuction with the material covered this week several field trips were taken: Racoon Bend field where a quadruple completion was being made in several overlying sands, the service and calibration laboratory for temperature and pressure survey bombs, Conroe Townsite field where special precautions and surface production practices are carried out to comply with city ordinances, and Conroe field where experimental work in well completion techniques was being conducted.

Week of 5 October 1959 - In this final week at the Gulf Coast division production office, casing design, gas lifting equipment design and fluid metering equipment were discussed in detail with the production equipment group. The extensive natural gas pipeline system operated by Humble in the Gulf Coast area was described and the control station for its operation visited.

Various other field trips were made which included: a trip to the Beaumont district production office (one of the subordinate areas within the division) and some of its associated production operations, and observation of a fracturing type workover in the Hull field.

Week of 12 October 1959 - In order to become familiarized with Humble production operations at the lowest organiza-

tional level, this week was spent at the Goose Creek Production District within the Gulf Coast Division. This district was a particularly good selection to provide a diverse sampling of production situations as its geographical area included inland, swamp, mud flat and bay fields.

Production and reservoir engineering problems unique to this district were included in discussions with district engineers. Field trips were made to assist in a practical understanding of these problems. They included: South Liberty field in swampy lowlands where all production facilities were located on elevated platforms for high water protection; a recently completed successful wildcat; the Batson field, one of Texas' oldest, now engaged in stripper production; and the separator island at Redfish Reef field in Galveston Bay.

Week of 19 October 1959 - Commenced a five week visit with the Eastern Production Division of Humble headquartered at New Orleans. This operating division includes within its area all of south Louisiana plus production operations present in Mississippi, Alabama and Florida. There are several unique aspects to south Louisiana production operations making this period in Eastern division a very important supplement to the training received in the Texas Gulf Coast. These unique features include; offshore operations in relatively deep water, extremely deep drilling and production, marsh operations, soft unconsolidated formations,

some extremely high pressure formations, less proration of production and relatively profitable gas production.

It was emphasized that drilling mud characteristics must be carefully regulated in south Louisiana to guard against several potential hazards; blowouts from extremely high pressure formations, sloughing of unconsolidated formations and lost circulation into highly permeable "thief" zones.

Initial drilling costs, as well as workover costs, are particularly high in marsh, swamp and offshore locations because of the problems of building working platforms and barging equipment to drilling sites. The money return on such undertakings must look particularly good to insure a reasonable payout period.

Far greater emphasis is given to gas production here since Humble's gas sales to interstate carriers is considerably greater in Louisiana than in Texas.

Week of 26 October 1959 - During this week time was divided between two production districts, Bayou Sale and Avery Island.

Bayou Sale district production is almost entirely in swamp and marsh locations in south central Louisiana. A field trip was made to Duck Lake field, a unitized gas field located in swamp inaccessible except by boat or helicopter. The entire field facilities including a gasoline plant are located on elevated platforms to provide protect-

ion from high water. An extreme internal corrosion problem is created by the sour gas produced from this field necessitating frequent well shutdown for injection of inhibitors and tubing repairs. Also visited were two typical swamp drilling sites where equipment was situated entirely on sunken barges.

Avery Island district is located in the southwestern corner of the state, but production is primarily centered at the well known Avery Island Salt dome. Production in this field is principally from the numerous reservoirs created by extensive faulting around the flanks of the dome. Several one-well secondary recovery projects were underway in this field.

Week of 2 November 1959 - Training with the Eastern Division was continued back at division headquarters during this week.

In discussions concerning proration and allocation of production in various states, it was noted that Louisiana has well allowables based on depth and Mississippi on MER's (maximum efficient rates), whereas Texas "yardstick" allowables are based on spacing and depth. LOuisiana, in contrast, to Texas, permits production of well allowables every day of the month.

Considerable time was spent with the reservoir engineering group discussing reservoir analysis techniques, logging programs and production economics as related to operations in the Eastern division.

The civil engineering group was visited briefly and their unique problems of construction in marsh and offshore locations discussed. An additional function of this civil engineering group is surveying and map making, a rather tedious though necessary job in the poorly charted and constantly changing marsh and shore areas.

Weeks of 9 and 16 November 1959 - A visit to the Grande Isle, Louisiana District, the location of the majority of Humble's offshore operations, took place during this period.

It was determined that the intensity of offshore oil and gas operations had been reduced to a fraction of its maximum in early 1957 for economic reasons. Offshore operations are inherently expensive, normally 3 or 4 times as great as corresponding activity ashore. Large production allowables would be required to pay out the tremendous investment for deepwater platform construction and drilling and the transportation needs involved. Though offshore allowables are somewhat higher than those inland, they are still not generally sufficient to give these operations a reasonable payout.

Hence, Humble has curtailed this type of activity to a relatively austere basis, with the aim of paying out the still existing debt and conducting new development only where it is well studied and near certain of bringing good profit.

Included in the current program are several develop-

mental and operational techniques designed to give maximum profit to investment ratios:

1. Multiple completions of offshore wells to obtain maximum possible production for each hole drilled.

2. Reservoir development in such a manner to insure rapid reservoir depletion thus minimizing the time during which expensive offshore platform and equipment maintenance must be carried on.

3. Balanced production in fields, such that all wells and reservoirs might be depleted nearly simultaneously obviating maintenance of offshore facilities for a few straggler wells.

4. Directional drilling to permit maximum field development from a single platform.

5. Extensive single-well "attic" and "cellar" secondary recovery programs in the well adapted steeply dipping salt dome reservoirs.

6. An extremely close study of economics in workover programs.

7. Limited sale of offshore gas, since ceilings on gas prices generally will not justify the cost of pipelines to shore.

Numerous field trips were taken during the visit to Grande Isle. Several offshore production and drilling platforms and the tremendous Freeport sulfur mine were visited. A round trip was made on a seagoing tug with barge in tow to pick up crude at a distant production platform.

PIPE LINE COMPANY

Week of 23 November 1959 - This week commenced a five week period of training at Houston with the Humble Pipe Line Company, a separate corporation wholly owned by Humble Oil and Refining Company. This company is a common carrier operating entirely within the state of Texas and transporting primarily crude oil, but additionally some refined products and LPG.

This week was spent at the main offices of the pipeline company, where the functions of its three main departments, technical, operations and accounting, were studied.

Subjects covered with the three departments were briefly as follows:

Technical - metering of crude, the increased acceptance of positive displacement meters in custody transfer at producing leases, bottom sediment and water determination in crude, vapor and filling loss control, corrosion control by coating and cathodic protection.

Operations - Oil movement scheduling, pipeline right of way acquisition, tariff schedules, communications systems associated with pipelining.

Accounting - The continual valuation of company assets necessitated by ICC regulations limiting company profits to not greater than 7% of assets, reports of receipts and deliveries of crude to the Texas Railroad commission, annual

financial statements of the company.

Period of 30 November to 23 December 1959 This period was spent in training with one of the operating divisions of the pipeline company headquartered at Houston. During this period, an excellent opportunity was provided to talk and travel with operating personnel and observe many phases of pipelining in the field. Field locations and control points were visited which included:

1. A trip with division management inspecting a newly acquired 30 mile right of way.

2. Observation of lease metering and stock tank gauging with a master meter.

3. Observation of pipeline dispatching at central control in Houston.

4. Visits to main and booster pumping stations including one in the process of conversion to automatic control.

5. Visit to the crude receiving terminal at Baytown refinery.

6. Visit to the products pumping station at the Baytown refinery.

7. Visits to several crude delivery stations where crude custody is transferred to refineries other than Humble.

8. Visits with maintenance and construction crews engaged in pipeline stringing, ditching, welding, laying road crossing and backfilling and tank repair.

Period of 24 December to 4 January 1960 - Taken as leave.

NOTE

Effective 1 January 1960, a merger was made of Humble Oil and Refining Company of Texas, Esso Standard Oil Company and Carter Oil Company, all affiliates of Standard Oil Company (New Jersey). The name given the new combined company is Humble Oil and Refining Company of Delaware. The previous Humble Company took the name of Humble Division. When Humble is referred to hereafter in this report, Humble Division is intended.

Week of 4 January 1960 - This week commenced a thirteen week period of training with the Manufacturing Department at the Humble Baytown Refinery. The coordinator for our refinery training, Mr. O. A. Brown, introduced us to members of refinery management and gave us a general indoctrination on the refinery and Baytown.

The Humble refinery processes about 282,000 barrels of crude per day ranking it second in thruput in the U. S. Its extremely diversified products include motor gasolines, aviation fuels, diesel fuels, heating and bunker fuel, lubricants of all types, butadiene and butyl rubber, asphalt, numerous solvents and hydrocarbons used by other industries.

First visited was the refinery's Coordination Division. Utilizing anticipated crude receipts and market forecasts for products, this group devises the refinery operating plan whereby crude may be processed as nearly as possible to meet market demand.

Training with the Technical and Process Divisions was scheduled for the first eight weeks at Baytown. These two divisions have closely related areas of interest though their responsibilities may be defined as staff and line, respectively. The Technical Division studies plant processes and operations and provides recommendations for improvement of efficiency and capability. The Process Divi-

sion has custody of the process equipment and operates it in accordance with orders from plant management and advice from the Technical Division.

As a preliminary to study of the various process units, a description of the general refinery flow diagram was given. Bottled samples of streams at different points were shown including crudes, intermediates and products.

Week of 11January 1960 - Distillation of crude oils were the subject of study during the first part of this week. Pipe stills, the basic process units in a refinery, are charged with crude at rates up to 90,000 barrels per day and yield six basic different fractions according to their boiling ranges.

Two process units associated with basic distillation are hydrodesufurization and deasphalting. The HDU removes sulfur compounds and certain metals from one of the pipestill fractions improving its quality as feed to catalytic cracking. The DAU removes asphaltic material from distillation residuum providing a heavy stream useable as commercial asphalt or as heavy fuel oil when blended and a light stream useable as cracking feed.

Catalytic cracking was covered during the latter half of this week. In this process heavy relatively worthless hydrocarbon molecules are broken down into lighter more valuable products by application of heat in the presence of

fine catalyst. This has made possible tremendous increases in the production of important products such as gasoline, and has given refineries important flexibility to divert crude stocks to light or heavy products depending upon current markets.

Week of 18 January 1960 - Study of catalytic cracking was completed during the first part of this week. Visits to some of these extremely large units were made.

As previously mentioned, the Technical Division constantly studies refinery equipment for the possibility of production of more valuable products from the same stock or reduction of operating costs. The system for economic evaluation of proposed modifications or new construction compares debits and credits for proposed projects. Credits are defined as anticipated increased revenue and debits as the costs of doing the necessary work. When credits adequately exceed debits, projects are submitted to management for approval.

Training with the group responsible for the Catalytic Light Ends Units took place during the latter part of this week. The CLEU's,in general, fractionate high pressure dis-tillate streams and gas from the cat crackers and refinery gas collected from tank vents and various process units into separate streams of ethylene, propane-propylene, butane-butylene, pentane-pentylene, light catalytic naptha, and heavy catalytic naptha. The ethylene stream is an end

product and is piped to nearby petrochemical industries. Propylene is polymerized using a catalyst into compounds of the motor gasoline boiling range and delivered to petrochemical customers. Other streams are used by refinery units in other processes.

Week of 25 January 1960 - This week was largely occupied with study of the virgin naptha or "solvents" processes. The units included in this group receive the light naptha (gasoline) fraction from the pipe stills and from it produce aromatics of various types including solvents, certain petrochemicals, aviation gasoline base stock and octane improvers for motor gasoline. All feed coming into this process area is run through catalytic hydroformers which dehydrogenate napthenes into aromatics and induce other reactions tending to increase the octane number of the feed. Subsequently, through extraction and distillation, benzene, toluene, xylene, various other solvents, petrochemicals and gasoline stocks are produced.

The area of the refinery now engaged in these operations comprises the old Baytown Ordnance Works which produced over 50% of the nitration grade toluene used by the Allies in World War II.

Week of 1 February 1960 - This week was spent with the "aviation" units, process equipment so named because its primary end product is alkylate and aviation and motor gasoline base stocks. The alkylation process fundamentally

reacts isobutylenes and isopentylenes with isobutane to produce alkylate, a family of branched parraffins used as a prime component in high octane gasolines.

Other units associated with this group isolate paraffins C_5 through C_9 by fractionation for use as motor gasoline base stocks and aliphatic solvents.

Week of 8 February 1960 - This week was spent at the Humble synthetic rubber plant, a part of the refinery where two common synthetic elastomers, butyl rubber and butadiene, are produced. The primary feed stream into the plant is a mixture of the normal and iso forms of butane and butylene.

Extracted isobutylene is polymerized with isoprene to make raw butyl rubber.

Extracted normal butylene is dehydrogenated to form butadiene, a liquid which is piped and shipped to rubber manufacturers.

Humble's butyl market is at present exceedingly good, particularly because of the recent introduction of butyl rubber passenger tires. Butadiene sales, on the other hand, are relatively poor because of an oversupply of this material on the market.

Week of 15 February 1960 - Lubricant manufacture was the subject of study during this week. Although lubricants amount to only about five percent of the total refinery product, they account for several times this percentage of the refinery's theoretical profits.

Two basic crude types are used at Baytown in lubricant manufacture; first Panhandle crude of paraffinic base processed into premium lubricants for automobiles and aircraft, and second, Coastal crude of napthenic base processed into industrial and heavy lubricants.

Lubricants must meet numerous specifications which depend upon thier intended use. These specifications are achieved in a lubricant by giving various combinations of available processes to the base stock, by combining with other lubricant blend stocks and finally by including certain additives.

In addition to the large variety of finished lubricants delivered from Baytown, there is a considerable sale of lube blend stocks in bulk quantities to other lubricant manufacturers, who ultimately blend to their own market specifications.

Week of 22 February 1960 - During this week the Economic Analysis group of the Technical division was visited. This group provides assistance to plant management and other groups at the refinery in some of the broader and more complex economic studies. Among their projects are capital budget planning, investment evaluation, manufacturing cost studies, evaluation of crude oil types and product blending optimization.

Weeks of 29 February and 7 March 1960 - During these two weeks training with the Operations Services Division was

conducted. This division , like the Process Divsion, has line responsibilities. They are, in general terms, the operation and maintenance of equipment providing services to the process units of the refinery. These services include:

1. Receipt of raw materials, namely crude, field natural gasoline and various process chemicals into tankage and dry storage.

2. Pumping and gauging of crude into pipe stills and appropriate disposition of the other materials. In addition, this area of responsibility includes pumping and gauging of intermediate streams around the refinery, and ultimately, the delivery of products to ships, pipelines, tank cars and trucks.

3. Blending of all products such as gasolines and lubricants and the packaging of products.

4. Arrangement for shipping of products.

5. Provision of utilities to the refinery.

It was noted that there was a definite trend toward contracting of outside services at the refinery. Railroad switching had been turned over entirely to an outside railroad. Electrical power, in ever increasing proportions, is being purchased from a public utilities company. The reason is merely that these services are cheaper from an outside source.

A short return trip to the Technical Division was made

during this period to visit the Petrochemical group. This group is involved in the study and planning of one of the refinery's most promising new fields. Petrochemicals, which broadly includes all products other than fuels and lubricants, are the source of a substantially increasing proportion of the refinery's profits. Though the refinery produces no final consumer products in this line, it manufactures materials which go into plastics, elastomers, insecticides, paints and many other petrochemical products.

Weeks of 14 and 21 March 1960 - Training was conducted during these two weeks with the refinery Maintenance and Construction division. This division, the largest in the refinery organization, is actually a service group to the line divisions which have custody of the basic refinery equipment.

The M & C division was in the process of a personnel reduction, and at its ultimate planned strength,will have only sufficient size to perform maintenance functions. Additional forces, when needed for construction, will be contracted. By this arrangement, layoffs whould be prevented during periods of little construction.

For maintenance purposes, the refinery grounds are divided into zones containing similar types of process equipment. A basic group of crafts men and supervisors is assigned each zone to carry out routine maintneance. The craftsmen are supplemented or shifted as workloads among zones vary

permitting flexibility and optimum utilization of available manpower. Other craftsmen and laborers are assigned to the central repair shops or to traveling maintenance groups such as telephone repair, tank cleaners and ground maintenance.

Considerable time was spent in study of material control and supply. An enormous supply and stocking operation is carried on at the refinery to meet the material needs of maintenance and construction work. It was noted that the refinery was making an extensive reduction of spare parts and material in stock as an economy measure. Most of these items have become readily available through local outside suppliers. Capital, previously tied up in idle stocks, is now being diverted to profit yielding projects.

During this period a special side trip outside the refinery was taken to the Humble Specialty Products Plant. This relatively small plant manufactures many of Humble's lesser known products, such as paints and protective coatings, crude and oil well treating compounds, corrosion inhibitors, and other materials used by Humble in its extensive production, pipeline, refining and marketing operations. These specialty products, though originally manufactured on a scale only sufficient to meet Humble's own needs, now find good markets elsewhere throughout the industrial and farming business.

Week of 28 March 1960 - During this last week of the training schedule at the Humble refinery, various supporting

staff groups were visited. These included employee relations, safety, medical, plant protection, accounting and service laboratories and research and development.

A concluding visit was made to the refinery manager, where thanks were expressed for the excellent training that had been provided us.

Week of 4 April 1960 - A six weeks period of training was commenced with the Marketing Department of Humble, whose headquarters are located in the Prudential Life building in Houston. The coordinator of our marketing training, Mr. A. O. Miller, provided us with a general indoctrination on departmental organization, marketing areas, and marketing policies and practices. The department functions are to market Humble products through retail and wholesale outlets and make bulk sales direct to industrial customers from the Humble refinery at Baytown.

During this week discussions were held with the Consumer Sales Division, which handles sales of products in bulk quantities through wholesale outlets to industry, farmers, and retailers.

Also visited was the Credit Division, which approves and administers the credit of Humble's retail and wholesale customer.

Week of 11 April 1960 - First visited during this week was the Accounting Division of marketing. The accounting functions of this division cover several subjects:

1. Financial accounting which encompasses computation of capital investment, tax data, product sales and other data, which, when systematically assembled is called a Statement of Operations and shows profit and loss on the numerous

marketed products.

2. General accounting which includes compilation and forwarding of bills to wholesale customers.

3. Stock control accounting which is the preparation of up-to-date reports of the amounts and locations of products at the many points of distribution in the Humble marketing chain.

4. Machine accounting which is the preparation and forwarding of bills to retail credit card customers.

The Sales Promotion and Advertising group visited later during the week prepares and executes the product advertising program through various media to the public.

A particularly enjoyable trip was made during the remainder of the week as guest of Humble to their Service Station Managers Convention in San Antonio. This convention provided an excellent opportunity to observe the good working relationship Humble marketing management enjoys with its sales organization in the field.

Week of 18 April 1960 - This week was largely spent with the Operations and Engineering division of marketing. This group functions to coordinate and supervise the following activities:

1. Distribution of products by various methods of transportation from source to point of sale.

2. Acquisition of service station and bulk station sites, design and construction of buildings and equipment.

3. Maintneance of existing facilities.

4. Preparation of capital and operating budget for these items.

On Friday of this week the opportunity was provided us to sit in on a major marketing staff meeting. Reports were received from managers of the various marketing areas and discussions were held on current problems of the business. The Manager of the Marketing Department presided over the meeting.

Week of 25 April 1960 - During this week training was conducted with the General Office Sales division of Marketing. This group handles Humble's large quantity product sales to other industries. Typical products included in this category are sales of petroleum intermediates and petrochemical stocks used as raw materials in other manufacturing processes, aviation fuels to airlines and the military, bunker fuels to ships and asphalt to road contractors.

A particularly important aspect of this type sale is technical service. In satisfying industrial customers, it is necessary that special care be given to adapting products to the specific needs of their equipment and processes.

Starting at midweek and continuing through the following week, marketing operations were studied in one of Humble's marketing areas. This area, located in southeast Texas, contains two typical types of marketing situations.

One is the metropolitan and industrial market of Houston. The other, largely rural, centers on the small town of Huntsville, Texas.

During the study of the Houston market, various industrial customers were visited in company with a Humble salesman. In dealing with industrial customers, like retail customers, service seems to be the keynote for successful sales. Considerable study must be given to the specialized needs of this type customer to insure that products recommended satisfactorily fill his special needs.

An interesting sidelight to study of the metropolitan market was the opportunity to witness the development of a gasoline price war, in which Humble and other major marketers were forced to reduce prices to compete with a general price drop initiated by independent marketers.

During the study of the rural market, a significant contrast was noted in the way of doing business with the relatively easygoing rural customer. A customer of this type considers a visit by his local bulk salesman a social event, so sales success may largely depend upon the ability to win the friendship of the customer.

Many rural retail outlets for automotive products are the combination grocery store/filling station type, where a financially successful business can be maintained despite amazingly small volume sales of gasoline and lubes. Though not a significant contributor to Humble's overall sales

volume, this type outlet is important in giving proper marketing coverage to all areas.

Week of 9 May 1960 During this last week of training with the Marketing Department, discussions were held with the Retail Sales Coordination group, Marketing Law and Marketing Research.

Humble's present efforts to expand its retail marketing areas and product lines were dwelt upon. Problems associated with moving into new areas include gaining of brand acceptance, acquiring high caliber station managers, and financing of prospective dealers. Experience gained in recent expansions into New Mexico and Arizona is expected to be helpful in proposed moves into California, Oklahoma and possibly Hawaii.

Expanding new product lines include tires, batteries and accessories. The enlargement of these lines is not only profitable, but is a necessary supplement to sales in today's diversified service stations.

The Marketing Law group provides counsel on such matters as real estate, sales contracts, trade marks, anti-trust problems, and claims by and against the company.

Marketing Research concerns itself with some of the less tangible aspects of marketing. Among them are:

1. Marketing analysis in advance of new product introduction.
2. Market analysis to accurately determine the success of

sales of certain products.

3. Sensitivity of market pricing and buying habits to various influences.

4. Evaluation of various promotional and advertising efforts.

5. Sales forecasting.

6. Product distribution studies.

Week of 16 May 1960 - During this week our training schedule returned us to the Humble headquarters building. A period of two weeks of study of various supporting staff departments was commenced.

First visited was the Public Relations and Advertising Department. Included in its public relations functions are preparation of news releases to the public, arrangement of company participation in major special events such as fairs, coordination of company contributions to charitable and institutional fund raising campaigns, publication of several company periodicals and administration of the touring service. In addition, institutional advertising (not specific product advertising) is administered by this department.

In a short visit to the Medical division of the Employee Relations Department, the company's program of environmental health, physical checkups and physical disability compensation were discussed.

During a one day visit with the Employee Placement division of Employee Relations subjects discussed were college recruiting, secretarial recruiting, military deferments for critical skills, transfers and counseling of employees.

The Safety division of Employee Relations includes in its responsibilities the preparation of recommendations regarding company operations where safety is of consequence,

determination of quality of company safety equipment, presentation of safety awards, investigation of accidents, and tabulation of safety statistics.

Week of 23 May 1960 - Groups visited during this last week with Humble included the Controller, Economics and Marine Departments.

The Controller of Humble has fiscal and accounting responsibilities which reach virtually every point in the operating organization.

The internal auditing program insures that good and prescribed accounting practices are followed throughout the company. Though ostensibly this extensive auditing may seem to be a burden expense, it is known to have paid its way many times by reducing company inefficiencies.

Accounting functions carried on for the company include preparation of profit and loss statements, tax data and budget plans. Much of this information is consolidated to provide reports to management, Standard Oil (New Jersey) various regulatory agencies and the federal government.

One rather specialized accounting group is the Crude Oil Accounting division. This group is, in effect, an exchange for all crude bought and sold by Humble. It pays royalties and working interest, and bills refiners and other buyers to whom crude is delivered.

The Economics Department, an extremely small group of

specialists, provides management with advice on the longer range aspects of foreign competition and supply and demand of crude, gas and energy.

The Marine Department serves as the shipping agent for tankers loading at the Baytown refinery and other points along the Gulf Coast where Humble is involved. Its responsibilities largely concern the ships of the Esso Standard tanker fleet.

On the last day with Humble, visits were paid to several persons concerned with our overall visit with the company; Mr. Russel Barber, manager of Production; Mr. Harry Pistole, Chief Production Engineer and Mr. Thomas Pennington, the overall program coordinator. Appropriate thanks were given to these individuals for the company's hospitality and the efforts made in designing and carrying out our very fine program of training.